ETSI TR 103 149 V1.2.1 (2019-07)

TECHNICAL REPORT

System Reference document (SRdoc);
DECT operating in the 1 900 MHz - 1 920 MHz band

Reference
RTR/ERM-579

Keywords
DECT, SRdoc

ETSI

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Sous-Préfecture de Grasse (06) N° 7803/88

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Foreword

This Technical Report (TR) has been produced by ETSI Technical Committee Electromagnetic compatibility and Radio spectrum Matters (ERM).

Modal verbs terminology

In the present document "**should**", "**should not**", "**may**", "**need not**", "**will**", "**will not**", "**can**" and "**cannot**" are to be interpreted as described in clause 3.2 of the ETSI Drafting Rules (Verbal forms for the expression of provisions).

"**must**" and "**must not**" are **NOT** allowed in ETSI deliverables except when used in direct citation.

Executive summary

The Digital Enhanced Cordless Telecommunications (DECT) system has started its operation in Europe in the band 1 880 MHz - 1 900 MHz. It has spread around the globe and has become the most successful digital cordless telephone system in the world.

DECT is well-known for digital cordless telephony and voice focused solutions (e.g. cordless phones, cordless headsets), in both domestic home market where low-cost single cell devices are used and in the business market, which requires multi-cell systems with more complex functionality. Wide band and super wide band speech codecs have been introduced in DECT and ETSI TC DECT is working on integrating the newest technology advancements available. Clearly, DECT successfully managed to address new markets by improvement and evolution of features and technology.

With the 'Ultra Low Energy' (ULE) Technical Specification DECT ([i.27] and [i.28]) is supporting applications in machine-to-machine communication, Internet of Things (IoT), and Smart Home Automation. Further, the ability of DECT to enable highly effective application specific protocols it attracted audio conferencing and wireless microphones (PMSE).

DECT enables highly-effective application-specific communication protocols as well as IP-based communication including support of the IPv6 standard. DECT is thereby already now well-positioned to serve as technology for several vertical industries (Industry 4.0, PMSE, e-Health, …).

DECT is part of the IMT-2000 family of standards called IMT-2000 FDMA/TDMA and is so far the only IMT standard available for license-exempt or de-licensed operation in IMT bands.

ETSI TC DECT is currently following two parallel development paths: DECT evolution and DECT-2020 [i.29]:

- DECT evolution is an update of the DECT standard to improve support of applications regarding latency, data-rate, and reliability based on the latest existing chipsets.
- DECT-2020 updates the air interface to OFDM FDMA/TDMA and will especially on support for URLLC and mMTC (including mesh networking) use cases in end-user deployed and operated networks. ETSI DECT-2020 is a candidate for being part of the IMT-2020 family of standards.

DECT has interworking profiles available for interworking with GSM and UMTS networks. ETSI TC DECT will define additional interworking profiles for LTE and 3GPP 5G-NR to provide complementary solution that can operate on license-exempt or licensed shared, local license or licensed IMT bands, with and without cellular operator involvement.

More than one billion DECT devices and several billion chips have been sold worldwide which continues to grow by over by more than 100 million per annum (Source: MZA).

Why more spectrum is needed?

DECT and the upcoming DECT evolution and DECT-2020 are very efficient, reliable and cost-effective system, as such being very attractive as it provides the right framework to manufacturers to deliver outstanding wireless solutions for a diverse set of applications demanded by the customers.

The reasons that more spectrum for DECT technology is required are basically two-fold.

New services to cater the increasing demand of digitalization of everything requires additional spectrum which is easy to access and available for everyone. This includes the demand of applications targeting Machine Type Communications (MTC) for IoT, Industry 4.0, Home automation enabling e.g. digital twin applications and PMSE use cases as well as the evolution from telephony service to wideband voice and multimedia data transmission.

Secondly, the evolution of the DECT technology from a standard primarily designed for cordless telephony towards a full flavoured local area telecommunications standard addressing wireless applications of various markets (e.g. telephony, IoT, home automation, Industry 4.0, Programme Making and Special Events (PMSE), e-Health, …). DECT technology is very successful in multiple markets and this continued success might soon lead to local area congestion issues in the DECT core band (1 880 MHz - 1 900 MHz). as the number of DECT terminals will increase massively.

The current limitation of the DECT band will become an increasing inhibitor to the further growth of the technology. The new products and applications will only be successful if adequate spectrum is available.

Advantages of the band 1 900 MHz - 1 920 MHz

Most technical documents are already available. The carrier numbers and positions for the use of DECT in the 1 900 MHz - 1 920 MHz band are already defined (see ETSI EN 300 175-2 [i.2], annex F) as a consequence of the IMT allocation. The harmonized standard for DECT over this band is already available as part of the IMT-2000 set. It is the ETSI EN 301 908-10 [i.22] (latest release, V4.2.2). An additional harmonized standard for DECT is ETSI EN 301 406 [i.30].

Therefore, an immediate implementation is possible. It should be noted that the frequencies 1 900 MHz - 1 930 MHz are already in use by DECT in non-EU countries and that there are already products (> 100 million of devices) in operation over these frequencies. Nearly all DECT chipset and RF parts vendors are already providing components compatible with the proposed new allocation. There is no other band where the DECT extension is as simple and immediate.

DECT technology gains its strength from license-exempt, but protected operation in 1 880 MHz - 1 900 MHz, which is the DECT core band designated by ERC/DEC(94)03 [i.31] for DECT operation.

The frequency band 1 900 MHz - 1 920 MHz is allocated to the mobile service on a primary basis in the European Common Allocation Table ERC Report 25 [i.32] and in the ITU Radio Regulations. The band is well suited and foreseen for TDD operation.

ETSI TC DECT is preparing IMT-2020 technology submission, which is based on TDD-mode well suited for 1 900 MHz - 1 920 MHz operation.

DECT is part of the IMT-2000 family of standards called IMT-2000 FDMA/TDMA and making use of TDD. Further, DECT technology enables already today within its standard other applications of land mobile services, like PMSE (SAP/SAB).

The band 1 900 MHz - 1 920 MHz would deliver supplementary radio spectrum resources to DECT operation and would provide effective means to overcome the likely future congestion of the DECT core band.

It is obvious that DECT operation on supplementary resources in 1 900 MHz - 1 920 MHz can follow different approaches regarding licensing regimes and access conditions.

Introduction

The present document includes necessary information to support the cooperation under the MoU between ETSI and the Electronic Communications Committee (ECC) of the European Conference of Post and Telecommunications Administrations (CEPT).

The present document was developed by ETSI TC DECT and approved by ERM by remote consensus on 17-06-2019. It contains final information.

1 Scope

The present document describes DECT operating in the frequency band 1 900 MHz - 1 920 MHz.

It includes in particular:

- Market information.
- Technical information.
- Regulatory issues.

2 References

2.1 Normative references

Normative references are not applicable in the present document.

2.2 Informative references

References are either specific (identified by date of publication and/or edition number or version number) or non-specific. For specific references, only the cited version applies. For non-specific references, the latest version of the referenced document (including any amendments) applies.

NOTE: While any hyperlinks included in this clause were valid at the time of publication, ETSI cannot guarantee their long term validity.

The following referenced documents are not necessary for the application of the present document but they assist the user with regard to a particular subject area.

[i.1] ETSI EN 300 175-1: "Digital Enhanced Cordless Telecommunications (DECT); Common Interface (CI); Part 1: Overview".

[i.2] ETSI EN 300 175-2: "Digital Enhanced Cordless Telecommunications (DECT); Common Interface (CI); Part 2: Physical Layer (PHL)".

[i.3] ETSI EN 300 175-3: "Digital Enhanced Cordless Telecommunications (DECT); Common Interface (CI); Part 3: Medium Access Control (MAC) layer".

[i.4] ETSI EN 300 175-4: "Digital Enhanced Cordless Telecommunications (DECT); Common Interface (CI); Part 4: Data Link Control (DLC) layer".

[i.5] ETSI EN 300 175-5: "Digital Enhanced Cordless Telecommunications (DECT); Common Interface (CI); Part 5: Network (NWK) layer".

[i.6] ETSI EN 300 175-6: "Digital Enhanced Cordless Telecommunications (DECT); Common Interface (CI); Part 6: Identities and addressing".

[i.7] ETSI EN 300 175-7: "Digital Enhanced Cordless Telecommunications (DECT); Common Interface (CI); Part 7: Security features".

[i.8] ETSI EN 300 175-8: "Digital Enhanced Cordless Telecommunications (DECT); Common Interface (CI); Part 8: Speech and audio coding and transmission".

[i.9] ETSI EN 300 176 (all parts): "Digital Enhanced Cordless Telecommunications (DECT); Test specification".

[i.10] Recommendation ITU-R M.1457: "Detailed specifications of the radio interfaces of International Mobile Telecommunications-2000 (IMT-2000)".

[i.11] ERC Report 31 (June 1994): "Compatibility between DECT and DCS1800".

[i.12] ERC Report 100 (February 2000): "Compatibility between certain radio communications systems operating in adjacent bands, evaluation of DECT / GSM 1800 compatibility".

[i.13] ECC Report 96 (March 2007): "Compatibility between UMTS 900/1800 and systems operating in adjacent bands".

[i.14] ECC Report 146 (June 2010): "Compatibility between GSM MCBTS and other services (TRR, RSBN/PRMG, HC-SDMA, GSM-R, DME, MIDS, DECT) operating in the 900 and 1 800 MHz frequency bands".

[i.15] CEPT Report 41 (November 2010): "Compatibility between LTE and WiMAX operating within the bands 880-915 MHz / 925-960 MHz and 1 710-1 785 MHz / 1 805-1 880 MHz (900/1 800 MHz bands) and systems operating in adjacent bands".

[i.16] ERC Report 65 (November 1999): "Adjacent band compatibility between UMTS and other services in the 2 GHz Band".

[i.17] CEPT Report 39 (June 2010): "Report from CEPT to the European Commission in response to the Mandate to develop least restrictive technical conditions for 2 GHz bands".

[i.18] ETSI TR 103 089: "Digital Enhanced Cordless Telecommunications (DECT); DECT properties and radio parameters relevant for studies on compatibility with cellular technologies operating on frequency blocks adjacent to the DECT frequency band".

[i.19] Recommendation ITU-R M.1036-5: "Frequency arrangements for implementation of the terrestrial component of International Mobile Telecommunications-2000 (IMT 2000) in the bands 806 960 MHz, 1 710-2 025 MHz, 2 110 2 200 MHz and 2 500-2 690 MHz".

[i.20] ITU Radio Regulations.

[i.21] Void.

[i.22] ETSI EN 301 908-10: "Electromagnetic compatibility and Radio spectrum Matters (ERM); Base Stations (BS), Repeaters and User Equipment (UE) for IMT-2000 Third-Generation cellular networks; Part 10: Harmonised Standard for IMT-2000, FDMA/TDMA (DECT) covering the essential requirements of article 3.2 of the Directive 2014/53/EU".

[i.23] ETSI TR 101 310: "Digital Enhanced Cordless Telecommunications (DECT); Traffic capacity and spectrum requirements for multi-system and multi-service DECT applications co-existing in a common frequency band".

[i.24] ETSI EN 300 444: "Digital Enhanced Cordless Telecommunications (DECT); Generic Access Profile (GAP)".

[i.25] ETSI EN 301 649: "Digital Enhanced Cordless Telecommunications (DECT); DECT Packet Radio Service (DPRS)".

[i.26] ETSI TS 102 527-1: "Digital Enhanced Cordless Telecommunications (DECT); New Generation DECT; Part 1: Wideband speech".

[i.27] ETSI TS 102 939-1: "Digital Enhanced Cordless Telecommunications (DECT); Ultra Low Energy (ULE); Machine to Machine Communications; Part 1: Home Automation Network (phase 1)".

[i.28] ETSI TS 102 939-2: "Digital Enhanced Cordless Telecommunications (DECT); Ultra Low Energy (ULE); Machine to Machine Communications; Part 2: Home Automation Network (phase 2)".

[i.29] ETSI TR 103 514: "Digital Enhanced Cordless Telecommunications (DECT); DECT-2020 New Radio (NR) interface; Study on Physical (PHY) layer".

[i.30] ETSI EN 301 406: "Digital Enhanced Cordless Telecommunications (DECT); Harmonised Standard covering the essential requirements of article 3.2 of the Directive 2014/53/EU".

[i.31] ERC/DEC(94)03: "ERC Decision of 24th October 1994 on the frequency band to be designated for the coordinated introduction of the Digital European Cordless Telecommunications system (ERC/DEC/(94)03)".

[i.32] ERC Report 25 (March 2019): "The European Table of Frequency; Allocations and Applications in the Frequency Range 8.3 kHz to 3000 GHz (ECA Table)".

[i.33] ECC Report 294 (February 2019): "Assessment of the spectrum needs for future railway mobile radio (RMR) communications".

3 Definition of terms, symbols and abbreviations

3.1 Terms

Void.

3.2 Symbols

For the purposes of the present document, the following symbols apply:

F_C Carrier Frequency
F_L Lower Frequency
F_U Upper Frequency

3.3 Abbreviations

For the purposes of the present document, the following abbreviations apply:

3GPP Third Generation Partnership Project
AM Amplitude Modulation
BER Bit Error Rate
CEPT Commission Européenne des Postes et Télécommunications
DECT Digital Enhanced Cordless Telecommunications
DPRS DECT Packet Radio Service
DSL Digital Subscriber Line
ECC Electronic Communications Committee
EIRP Effective Isotropic Radiated Power
ERC European Radiocommunications Committee
FDMA Frequency Division Multiple Access
FRMCS Future Railway Mobile Communication System
GAP Generic Access Profile
GoS Grade of Service
GSM Global System for Mobile Communications
GSM-R Global System for Mobile Communications – Rail(way)
ICT Information Communication Technology
iDCS instant Dynamic Channel Selection
IMT International Mobile Telecommunications
IoT Internet of Things
IP Internet Protocol
IPR Intellectual Property Rights
ITU International Telecommunications Union
ITU-R International Telecommunication Union - Radiocommunication sector
M2M Machine to Machine
MAC Medium Access Control
mMTC massive MTC
MTC Machine Type Communication
NR New Radio
NTP Normal Transmitted Power

OFDM	Orthogonal Frequency-Division Multiplexin
PMSE	Programme Making and Special Event
PP	Portable Part
RF	Radio Frequency
RFP	Radio Fixed Part
RLL	Radio Local Loop
SRdoc	System Reference document
TDD	Time Division Duplex
TDMA	Time Division Multiple Access
UL/DL	UpLink/DownLink
ULE	Ultra Low Energy
UMTS	Universal Mobile Telecommunication System
URLLC	Ultra-Reliable Low Latency Communications
WLAN	Wireless Local Area Networks
WRS	Wireless Relay Station

4 Comments on the System Reference Document

The following comments have been raised by ETSI members:

- Comments from the Ministère de l'Economie et des Finances (France):
  - The 1 900 MHz - 1 920 MHz band is considered by CEPT as a candidate frequency band for the future railway mobile communications system (successor of GSM-R) and for professional UAS. Therefore, studies of DECT in this band may be only considered once the primary user(s) will be chosen by CEPT.
- Comments from UIC (UGFA):
  - Clause 8.2, second paragraph:

  UIC understands that currently the 1 900 MHz - 1 920 MHz is used for DECT applications as follows:

    - 1 880 MHz - 1 900 MHz - Europe and Australasia
    - 1 900 MHz - 1 920 MHz - China, but in negotiation and expected to prefer other technology
    - 1 893 MHz - 1 906 MHz - Japan
    - 1 910 MHz - 1 930 MHz - Latin America
    - 1 910 MHz - 1 920 MHz - Brazil
    - 1 920 MHz - 1 930 MHz - US and Canada

  This implies that the 1 900 MHz - 1 910 MHz to date is only used in Japan for DECT.

  The full 1 900 MHz - 1 920 MHz band is currently under examination for rail usage (possibly as primary user) under the EC mandate on FRMCS as a complementary band (to allow for at least 10 MHz TDD for rail probably in the lower 10 MHz). The ECC report 294 [i.33] has confirmed the necessity of a complementary band for railways.

  Therefore, UIC oppose to the current request for DECT to use the 1 900 MHz - 1 920 MHz.

  Clause 8.2, last paragraph:

  UIC considers that under appropriate conditions it could be possible to operate e.g. the 1 900 MHz - 1 910 MHz by railways and DECT to use the 1 900 MHz band. Both indoor and outdoor DECT use cases need to be considered. For this, use cases such as DECT usage in railway stations need to be analysed to guarantee appropriate coexistence with railway usage of this frequency band, especially in view of the case where DECT uses 1 W EIRP.

  Clause 8.3 third paragraph:

See comment at clause 8.2.
Furthermore a definition of indoor environments is needed as the building/penetration losses vary widely within Europe

Clause 9.1:

UIC would like to request detailed analyses of this statement. In our understanding of the current ERC Report 25 [i.32] allocation: Although RR footnote 5.388 identifies the band 1 885 MHz - 2 025 MHz as being intended to become an IMT band, the footnote 5.388A clarifies that for region 1 this is only applicable to high altitude platform stations.

Clause 9.2: same comments as to clause 8.

Clause 9.2 third paragraph:

UIC questions if this is correct as different use of the same standard on adjacent band is likely to need a guard band in between.

5 Presentation of the system or technology

DECT is a general radio access technology for wireless telecommunications, for cell radii ranging from a few meters to several kilometres, depending on application and environment. The DECT technology provides a comprehensive set of protocols which provide the flexibility to interwork between numerous different applications and networks. The standard specifies a high capacity TDMA/TDD radio interface supporting symmetric and asymmetric connections, connection oriented and connectionless data transport and provides security and confidentiality services. The mandatory instant Dynamic Channel Selection (iDCS) messages and procedures provide effective co-existence of uncoordinated private and public systems on the common designated DECT frequency band and avoid any need for traditional frequency planning.

The first version of the multipart DECT base standard ETSI EN 300 175 was published in 1992. In the same year the first DECT speech and data products appeared on the market. Three years later the ETSI EN 300 444 [i.24], the 'Generic Access Profile' (GAP), was completed, which is an interoperability profile for DECT speech products.

In the year 2000 the ITU approved DECT as an air-interface of IMT-2000 and the technology was included in the corresponding Recommendation ITU-R M.1457 [i.10]. In the same year the DECT Packet Radio Service (DPRS) specification ETSI EN 301 649 [i.25] was published. In 2003 high level modulation modes with a rate of up to ~7 Mbit/s and turbo coding were introduced in the base standard.

With the introduction of 'DECT New Generation' internet connectivity is provided to the user. Together with voice over IP high quality wide band and super wide band speech codecs have been introduced in DECT. ETSI TS 102 527-1 [i.26] was first published in 2007. In later parts several supplementary services as well as headset management and software update over the air have been standardized. For applications with increased security requirements additional authentication and encryption algorithms have been defined.

Already in 2012, TC DECT started to work on a new application of DECT for completely different markets. DECT Ultra Low Energy (ULE) ([i.27] and [i.28]) targets IoT applications. The low power consumption of ULE technology extends battery life (typically up to ten years) and, with New Generation DECT, connectivity to the Internet is already available, which makes the technology ideal for sensors, alarms, machine-to-machine applications and industrial automation. Further, the ability of DECT to enable highly effective application specific protocols it attracted audio conferencing and wireless microphones (PMSE).

DECT enables highly-effective application-specific communication protocols as well as IP-based communication including support of the IPv6 standard. DECT is thereby already now well-positioned to serve as technology for several vertical industries (Industry 4.0, PMSE, e-Health, …).

ETSI TC DECT is currently following two parallel development paths: DECT evolution and DECT-2020 [i.29]:

- DECT evolution is an update of the DECT standard to improve support of applications regarding latency, data-rate, and reliability based on the latest existing chipsets.
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DECT has interworking profiles available for interworking with GSM and UMTS networks. ETSI TC DECT will define additional interworking profiles for LTE and 3GPP 5G-NR to provide complementary solution that can operate on license-exempt or licensed shared, local license or licensed IMT bands, with and without cellular operator involvement.

6 Market information

The Digital Enhanced Cordless Telecommunications (DECT) system has started its operation in Europe in the band 1 880 MHz - 1 900 MHz. It has spread around the globe and has become the most successful digital cordless telephone system in the world. The system has been adopted in over 110 countries.

According to recent market research studies on DECT cordless telephony, today's installed base is more than 1 000 million devices. A market volume of more than 90 million devices per year for personal use and about 45 million devices per year for enterprise use was reached in 2018. Market research institutes report a yearly growing rate of 3 % to 5 % per year in the cordless telephony market. DECT telephony products now account for more than 80 % of the world market in cordless telephony.

By improvement and evolution of features and technology, DECT successfully managed to address new markets.

With the 'Ultra Low Energy' (ULE) Technical Specification DECT ([i.27] and [i.28]) is supporting applications in machine-to-machine communication, Internet of Things (IoT), and Smart Home Automation. The M2M/IoT market is a global multi-billion-dollar market, where DECT ULE is well positioned and successful further backed due to its availability in many WLAN/DSL access points deployed by the customer base of major telecommunication companies.

Further, the ability of DECT to enable highly effective application specific protocols has attracted audio conferencing and wireless microphones (PMSE). One can note that all major manufactures of audio industry have DECT based products like office headsets, wireless microphones for semi-professional applications and conferencing solutions.

DECT enables highly-effective application-specific communication protocols as well as IP-based communication including support of the IPv6 standard. DECT is thereby already now well-positioned to serve as technology for several vertical industries (Industry 4.0, PMSE, e-Health, …).

DECT evolution and DECT-2020 will continue this success story of DECT and will for sure continue to provide an attractive communication solution within the whole eco-system of ICT.

7 Technical information

7.1 Detailed technical description

A detailed technical description can be found in the DECT base standard ETSI EN 300 175 parts 1 [i.1] to 8 [i.8] and in the test specifications ETSI EN 300 176 parts 1 and 2 [i.9].

7.2 Technical parameters and implications on spectrum

7.2.1 Status of technical parameters

7.2.1.1 Current ITU and European Common Allocations

Relevant documents are the ITU Radio Regulations [i.20] and the Recommendation ITU-R M.1036-5 [i.19].

7.2.1.2 Sharing and compatibility studies already available

The following documents, which include compatibility studies concerning DECT, have been identified and may be used by CEPT for their sharing and compatibility studies.

- ERC Report 31 [i.11].

- ERC Report 100 [i.12].
- ECC Report 96 [i.13].
- ECC Report 146 [i.14].
- CEPT Report 41 [i.15].
- ERC Report 65 [i.16].
- CEPT Report 39 [i.17].
- ETSI TR 103 089 [i.18].

7.2.1.3 Sharing and compatibility issues still to be considered

The use of 1 900 MHz - 1 920 MHz is currently also considered for other applications, e.g. drones and railways.

However, considering open access to 1 900 MHz - 1 920 MHz spectrum for multiple IoT services and other services would strengthen European economy in terms of digitalization capabilities. In this area the 2,4 GHz spectrum has proven its importance as for innovative new digital services.

7.2.2 Transmitter parameters

7.2.2.1 Transmitter Output Power/Radiated Power

The NTP is the transmitted power averaged from the start of symbol p0 of the physical packet, to the end of the physical packet. The NTP should be less than 250 mW (24 dBm) per simultaneously active transceiver at extreme conditions.

Typically the fixed part is transmitting at a constant power level, but this power may be less than the maximum allowed value. For the portable part a power control algorithm has been defined and normally the portable part will adjust the transmit power to the required level.

Table 1: Emissions due to modulation

Emissions on RF channel "Y"	Maximum power level
Y = M ± 1	160 µW
Y = M ± 2	1 µW
Y = M ± 3	80 nW
Y = any other DECT channel	40 nW
NOTE: For Y = "any other DECT channel", the maximum power level should be less than 40 nW except for one instance of a 500 nW signal.	

The power in RF channel Y is defined by integration over a bandwidth of 1 MHz centred on the nominal centre frequency, Fy, averaged over at least 60 % but less than 80 % of the physical packet, and starting before 25 % of the physical packet has been transmitted but after the synchronization word.

The power level of all modulation products (including Amplitude Modulation (AM) products due to the switching on or off of a modulated RF carrier) arising from a transmission on RF channel M should, when measured using a peak hold technique, be less than the values given in table 2. The measurement bandwidth should be 100 kHz and the power should be integrated over a 1 MHz bandwidth centred on the DECT frequency, Fy.

Table 2: Emissions due to transmitter transients

Emissions on RF channel "Y"	Maximum power level
Y = M ± 1	250 µW
Y = M ± 2	40 µW
Y = M ± 3	4 µW
Y = any other DECT channel	1 µW

7.2.2.1a Antenna Characteristics

The antenna gain should be equal or less than 6 + X dBi. X is the difference in dB between 24 dBm and the NTP expressed in dBm for any one active transmitter. Smart antennas may be used.

NOTE: This corresponds to 1 W effective isotropic radiated power. In addition the maximum value for the normal transmitted power is 250 mW.

7.2.2.2 Operating Frequency

The carrier frequencies are defined by:

- $Fc = F9 + c \times 1{,}728$ MHz

Where:

- F9 = 1 881,792 MHz; and
- c = 11, 12, 13, ..., 21.

Table 3: Carrier frequencies

Carrier number c	Rf-band number	Carrier frequency (MHz)
11	00001	1 900,800
12	00001	1 902,528
13	00001	1 904,256
14	00001	1 905,984
15	00001	1 907,712
16	00001	1 909,440
17	00001	1 911,168
18	00001	1 912,896
19	00001	1 914,624
20	00001	1 916,352
21	00001	1 918,080

7.2.2.3 Bandwidth

The typical bandwidth is 1 MHz.

7.2.2.4 Unwanted emissions

The peak power level of any RF emissions outside the radio frequency band allocated to DECT, as defined in clause 7.2.2.1, when a radio end point has an allocated physical channel, should not exceed 250 nW at frequencies below 1 GHz and 1 μW at frequencies above 1 GHz. The power should be defined in the bandwidths given in table 4. If a radio end point has more than one transceiver, any out of band transmitter intermodulation products should also be within these limits.

Table 4: Measurement bandwidth for the spurious emissions

Frequency offset, f_o From edge of band	Measurement bandwidth
0 MHz ≤ fo < 2 MHz	30 kHz
2 MHz ≤ fo < 5 MHz	30 kHz
5 MHz ≤ fo < 10 MHz	100 kHz
10 MHz ≤ fo < 20 MHz	300 kHz
20 MHz ≤ fo < 30 MHz	1 MHz
30 MHz ≤ fo < 12,75 GHz	3 MHz

Measurements should not be made for transmissions on the RF channel closest to the nearest band edge for frequency offsets of up to 2 MHz.

In addition, not regarding up to 2 instances of a continuous-wave spurious signal for PPs for which the total peak power level should be less than 250 nW as measured in a 3 MHz measurement bandwidth, the peak power level should be less than 20 nW in a 100 kHz measuring bandwidth for the following broadcast bands:

- 47 MHz - 74 MHz;
- 87,5 MHz - 108 MHz;
- 108 MHz - 118 MHz;
- 174 MHz - 230 MHz;
- 470 MHz - 862 MHz.

7.2.3 Receiver parameters

7.2.3.1 Radio receiver sensitivity

The radio receiver sensitivity should be -83 dBm (i.e. 60 dBμV/m), or better.

7.2.3.2 Receiver intermodulation performance

With a call set up on a particular physical channel, two interferers are introduced so that they can produce an intermodulation product on the physical channel already in use.

If RF carrier number "d" is in use, a reference DECT interferer and a continuous wave interferer are introduced on DECT carriers "e" and "f" to produce an intermodulation product on carrier "d". Neither "e" nor "f" should be adjacent to "d".

The received level of carriers "e" and "f" should be -48 dBm and the received level of carrier "d" should be -80 dBm.

With "e" and "f" being received 32 dB greater than "d", and "d" being received at -80 dBm, the receiver should still operate with a BER of less than 0,001 in the D-field.

7.2.3.3 Radio receiver interference performance

With a received signal strength of -73 dBm (i.e. 70 dBμV/m) on RF channel M, the BER in the D-field should be maintained better than 0,001 when a modulated, reference DECT interferer of the indicated strength is introduced on the DECT RF channels shown in table 5.

Table 5: Receiver interference performance

Interferer on RF channel "Y"	Interferer signal strength	
	(dBμV/m)	(dBm)
Y = M	59	-84
Y = M ± 1	83	-60
Y = M ± 2	104	-39
Y = any other DECT channel	110	-33
NOTE: The RF carriers "Y" should include the three nominal DECT RF carrier positions immediately outside each edge of the DECT band.		

7.2.3.4 Radio receiver blocking

With the desired signal set at -80 dBm, the BER should be maintained below 0,001 in the D-field in the presence of any one of the signals shown in table 5.

The receiver should operate on a frequency band allocation with the low band edge F_L MHz and the high band edge F_U MHz.

Table 6: Receiver blocking

Frequency (f)	Continuous wave interferer level	
	For radiated measurements dB μV/m	For conducted measurements dBm
25 MHz ≤ f < F_L - 100 MHz	120	-23
F_L - 100 MHz ≤ f < F_L - 5 MHz	110	-33
$\lvert f - F_C \rvert$ > 6 MHz	100	-43
F_U + 5 MHz < f ≤ F_U + 100 MHz	110	-33
F_U + 100 MHz < f ≤ 12,75 GHz	120	-23

7.2.4 Channel access parameters

7.2.4.1 Frame length

The frame length is 10 ms.

7.2.4.2 Channel selection

The channel selection is described in clause 11.4 of the MAC layer specification [i.3].

Before initiating a radio transmission, it is required to select the least interfered channel. This is achieved by measuring the field strength on each channel or if a channel is found, whose signal level if below a defined value that indicates that this channel is free. During a radio transmission the signal quality is continuously monitored and if the signal is interfered or if a better channel becomes available, then a seamless handover is performed. This means that the DECT system is always optimizing the channel usage in order to achieve the optimum overall transmission quality.

7.3 Information on relevant standard(s)

Relevant standards are:

- ETSI EN 300 175-1 [i.1]
- ETSI EN 300 175-2 [i.2]
- ETSI EN 300 175-3 [i.3]
- ETSI EN 300 175-4 [i.4]
- ETSI EN 300 175-5 [i.5]
- ETSI EN 300 175-6 [i.6]
- ETSI EN 300 175-7 [i.7]
- ETSI EN 300 175-8 [i.8]
- ETSI EN 300 176 (all parts) [i.9]
- Recommendation ITU-R M.1457 [i.10]
- ETSI EN 301 908-10 [i.22]
- ETSI TS 102 939-1 [i.27]
- ETSI TS 102 939-2 [i.28]
- ETSI EN 301 406 [i.30]

8 Radio spectrum request and justification

8.1 Why additional spectrum is needed

DECT and the upcoming DECT evolution and DECT-2020 are very efficient, reliable and cost-effective system, as such being very attractive as it provides the right framework to manufacturers to deliver outstanding wireless solutions for a diverse set of applications demanded by the customers.

The reasons that more spectrum for DECT technology is required are basically two-fold.

New services to cater the increasing demand of digitalization of everything requires additional spectrum which is easy to access and available for everyone. This includes the demand of applications targeting Machine Type Communications (MTC) for IoT, Industry 4.0, Home automation enabling e.g. digital twin applications and PMSE use cases as well as the evolution from telephony service to wideband voice and multimedia data transmission.

Secondly, the evolution of the DECT technology from a standard primarily designed for cordless telephony towards a full flavoured local area telecommunications standard addressing wireless applications of various markets (e.g. telephony, IoT, home automation, Industry 4.0, Programme Making and Special Events (PMSE), e-Health, …). DECT technology is very successful in multiple markets and this continued success might soon lead to local area congestion issues in the DECT core band (1 880 MHz - 1 900 MHz). as the number of DECT terminals will increase massively.

The current limitation of the DECT band will become an increasing inhibitor to the further growth of the technology. The new products and applications will only be successful if adequate spectrum is available.

8.2 What are the specific advantages of the band 1 900 MHZ - 1 920 MHz

Advantages of the band 1 900 MHz - 1 920 MHz

Most technical documents are already available. The carrier numbers and positions for the use of DECT in the 1 900 MHz - 1 920 MHz band are already defined (see ETSI EN 300 175-2 [i.2], annex F) as a consequence of the IMT allocation. The harmonized standard for DECT over this band is already available as part of the IMT-2000 set. It is the ETSI EN 301 908-10 [i.22]. An additional harmonized standard for DECT is ETSI EN 301 406 [i.30].

Immediate implementation is possible. It should be noted that the frequencies 1 900 MHz - 1 930 MHz are already in use by DECT in non-EU countries and that there are already products (> 100 million of devices) in operation over these frequencies. Nearly all DECT chipset and RF parts vendors are already providing components compatible with the proposed new allocation. There is no other band where the DECT extension is as simple and immediate.

DECT technology gains its strength from license-exempt, but protected operation in 1 880 MHz - 1 900 MHz, which is the DECT core band designated by ERC/DEC(94)03 [i.31] for DECT operation.

The frequency band 1 900 MHz - 1 920 MHz is allocated to the mobile service on a primary basis in the European Common Allocation Table (ERC Report 25 [i.32]) and in the ITU Radio Regulations. The band is well suited and foreseen for TDD operation.

DECT is part of the IMT-2000 family of standards called IMT-2000 FDMA/TDMA and making use of TDD. Further, DECT technology enables already today within its standard other applications of land mobile services, like PMSE (SAP/SAB).

The band 1 900 MHz - 1 920 MHz would deliver supplementary radio spectrum resources to DECT operation and would provide effective means to overcome the likely future congestion of the DECT core band (1 880 MHz - 1 900 MHz).

It is obvious that DECT operation on supplementary resources in 1 900 MHz - 1 920 MHz can follow different approaches regarding licensing regimes and access conditions, e.g. license-exempt operation indoors and site-licensing outdoors to foster coexistence with applications such as railways and drones, if foreseen as additional, but local area usages in the band 1 900 MHz - 1 920 MHz.

8.3 The request

It is proposed to change the regime for DECT in the 1 900 MHz - 1 920 MHz band to allow license exempt operation, in the same way as in the original DECT band (1 880 MHz - 1 900 MHz).

The band 1 900 MHz - 1 920 MHz would deliver supplementary radio spectrum resources to DECT operation and would provide effective means to overcome the likely future congestion of the DECT core band (1 880 MHz - 1 900 MHz).

Nevertheless, it is obvious that DECT operation on supplementary resources in 1 900 MHz - 1 920 MHz can follow different approaches regarding licensing regimes and access conditions, e.g. license-exempt operation indoors and site-licensing outdoors (e.g. PMSE and Industry 4.0) to foster coexistence with applications such as railways and drones, if foreseen as local area usages in the band 1 900 MHz - 1 920 MHz.

It is worth pointing out, that applications such as drones and potentially railways could also make use of the DECT technology and contributions to ETSI TC DECT for the development of DECT-2020 by these industries are more than welcome.

9 Regulations

9.1 Current regulations

Relevant documents are the ITU Radio Regulations [i.20] and the Recommendation ITU-R M.1036-5 [i.19].

The frequency band 1 900 MHz - 1 920 MHz is allocated to the mobile service on a primary basis in the European Common Allocation Table (ERC Report 25 [i.32]) and in the ITU Radio Regulations. The band is well suited and foreseen for TDD operation. DECT is part of the IMT-2000 family of standards called IMT-2000 FDMA/TDMA and making use of TDD.

Further, DECT technology enables already today within its standard other applications of land mobile services, like PMSE (SAP/SAB).

9.2 Proposed regulation and justification

Due to existing ITU Radio Regulations, the frequencies 1 900 MHz - 1 930 MHz are already in use by DECT in non-EU countries and that there are already products (more than 100 million of devices) in operation over these frequencies. Nearly all DECT chipset and RF parts vendors are already providing components compatible with the proposed new allocation. There is no other band where the DECT extension is as simple and immediate.

Proposed is the allocation of the band 1 900 MHz - 1 920 MHz for operation of DECT. This band is adjacent to the existing DECT band and can therefore be considered as an extension of the existing band. This maximizes the spectrum efficiency as no guard band is needed between two DECT bands and therefore two additional carriers become available.

Nevertheless, it is obvious that DECT operation on supplementary resources in 1 900 MHz - 1 920 MHz can follow different approaches regarding licensing regimes and access conditions, e.g. license-exempt operation indoors and site-licensing outdoors (e.g. PMSE and Industry 4.0) to foster coexistence with applications such as railways and drones, if foreseen as additional, but local area usages in the band 1 900 MHz - 1 920 MHz.

It is worth pointing out, that applications such as drones and potentially railways could also make use of the DECT technology and contributions to ETSI TC DECT for the development of DECT-2020 by these industries are more than welcome to check support of these applications or to develop proper technical means.

Annex A:
Simulation results for wireless office systems

A.1 Simulation scenario

Annex A is based on results which have been published in the ETSI TR 101 310 [i.23].

Terminals are randomly positioned (with uniform distribution) within a reference three-storey building 100 m × 100 m × 9 m, in which 16 base stations are regularly spaced on each storey (figure A.1). Each terminal generates 0,2 E of traffic and the mean duration of the call is 120 s.

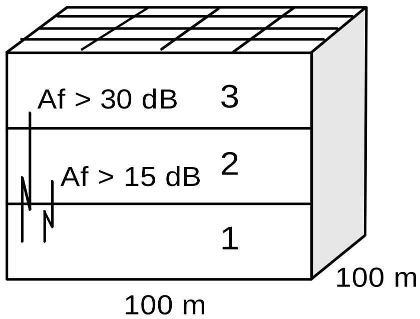

Figure A.1: Reference building

Two different radio propagation models have been considered:

The ETSI model assumes a propagation exponent accounting for the path loss equal to 3,5, an attenuation between floors of 15 dB, and a shadow margin factor uniformly distributed in the range ±10 dB.

$$l(d) = 30 + 35 \log (d) + 15 \times (\text{number of floors})$$

A model for more heavy construction buildings, the Ericsson loss Model, has also been used.

Ericsson-in-Building loss model:

$$l(d) = 38 + 30 \log (d) + 15 \times (\text{number of floors}) \qquad d < 20 \text{ m}$$

$$l(d) = -1 + 60 \log (d) + 15 \times (\text{number of floors}) \qquad 20 \text{ m} < d < 40 \text{ m}$$

$$l(d) = -97 + 120 \log (d) + 15 \times (\text{number of floors}) \qquad d > 40 \text{ m}$$

The shadowing margin is modelled with a log-normal law with zero mean and a standard deviation of 8 dB.

In both the models the Rayleigh fade margin is 10 dB, when antenna diversity is applied; the C/I threshold is 11 dB, so the call set-up threshold is 21 dB.

The system spectrum allocation, the radio parameters, such as transmitted power, receiver noise floor, adjacent channel rejection factors, etc. and the call procedures, such as set-up and handover for both single and multi-bearer channel allocation models, are in accordance with the DECT specifications (see ETSI EN 300 175-3 [i.3]). Base station blind slot information is available at the PPs for the simulations in clause A.2, whilst not in clause A.2.3.

The aim of this work is to evaluate the GoS versus the average traffic per base station and the total number of available DECT carriers (total spectrum). GoS is defined as follows:

$$\text{GOS} = \frac{\text{number of blocked calls} + 10 \times \text{number of interrupted calls}}{\text{total number of calls}}$$

In simulation works dealing with DECT performance (ETSI TR 101 310 [i.23]) the desired GoS should be less than 1 %.

A.2 Simulation results

A.2.1 Introduction

For the simulations in this clause, DECT capacity in offices, intracell and intercell handover is provided and 20 % of the users are moving. The capacity is expressed in average speech traffic (Erlangs) per base station, as a function of the number of carriers that has been allocated to the system. Each base station contains two radios and the portable parts use uplink power control, in order to be able to support 12 wideband voice channels per base station. Table A.1 provides a summary for the 1 % blocking case using the ETSI loss model. Table A.2 is the same summary for a heavy construction building where the Ericsson Loss model has been used.

Table A.1: Average traffic per base station (at 1 % blocking probability) in an office application as a function of total number of DECT access channels (the ETSI loss model has been used)

No. of carriers/ access channels	Average traffic per base station	Average number of users (at 0,2 E) per base station	Traffic/km²/floor, if 625 m² per base station (25 m separation)
4/24	1,3 E	7	2 100 E
8/48	3,2 E	16	5 100 E
12/72	4,5 E	23	7 200 E
16/96	5,3 E	27	8 500 E
20/120	5,6 E	28	9 000 E

It can be seen from table A.1 that the capacity is C/I limited up to about 12 carriers. For higher number of carriers the capacity becomes trunk limited (maximum 12 simultaneous calls per base station). For table A.2 the limit is at 8 to 10 carriers.

Table A.2: Average traffic per base station (at 1 % blocking probability) in an office application as a function of total number of DECT access channels (the Ericsson loss model has been used)

No. of carriers/access channels	Average traffic per base station	Average number of users (at 0,2 E) per base station	Traffic/km²/floor, if 625 m² per base station (25 m separation)
4/24	2,1 E	11	3 400 E
8/48	4,4 E	22	7 000 E
12/72	5,5 E	26	8 800 E
16/96	6,1 E	31	9 800 E
20/120	6,1 E	31	9 800 E

Regarding capacity calculations, the figure average traffic (E) per base station is the essential parameter. The traffic density figures, traffic/km^2 and number of users per floor, depend directly on the base station density (base stations per km^2 or per floor). The results below may be extended to cover other base station densities, by varying the base station density, but keeping the E/base figures from the tables. It may be concluded that with about 25 m base station separation 20 carriers (40 MHz) will provide about 10 000 E/km^2.

A.2.2 Capacity in large office landscapes with soft partitioning

Simulations have also been made for a very large single floor 300 × 300 m office landscape with semi-high soft partitionings, but without interior walls. The propagation model is:

$$L = 41 + 20\log(d) + \Gamma \text{ x } \text{Max}\left[0, (d-10)\right] \text{dB}, \quad \text{where } \Gamma \text{ is } 0{,}37 \text{ dB / m or } 0{,}59 \text{ dB / m.}$$

The higher attenuation figure corresponds to a high density of partitions.

The results are summarized in table A.3.

Table A.3: Average traffic per base station (at 0,5 % blocking probability) in a large (300 m x 300 m) office landscape with soft partitioning as a function of total number of DECT access channels and as a function of total traffic

No. of carriers/ access channels (Γ)	Average traffic per base station	Number of base stations (base station separation, rectangular grid)	Traffic/km² (total traffic in the office)
20/120 (0,37 dB/m)	4,2 E	12 (87 m)	556 E (50 E)
20/120 (0,37 dB/m)	6,9 E	36 (50 m)	2 778 E (250 E)
20/120 (0,37 dB/m)	7,8 E	64 (38 m)	5 556 E (500 E)
20/120 (0,37 dB/m)	5,9 E	169 (23 m)	11 111 E (1 000 E)
20/120 (0,59 dB/m)	2,5 E	20 (67 m)	556 E (50 E)
20/120 (0,59 dB/m)	6,9 E	36 (50 m)	2 778 E (250 E)
20/120 (0,59 dB/m)	7,8 E	64 (38 m)	5 556 E (500 E)
20/120 (0,59 dB/m)	6,4 E	156 (24 m)	11 111 E (1 000 E)

It can be seen that the installation is range limited for the low traffic cases, and starts to become interference limited for the high traffic density cases. It can also be seen that with about 24 m base station separation 20 carriers (40 MHz) will provide about 10 000 E/km^2, as for the simulations at the beginning of clause A.2.

A.2.3 Interference to and from offices

The potential Interference to and from different wireless office systems in the same building has also been analysed. Below the main results are presented.

Two different scenarios are taken into account:

a) a single system in the building;

b) three different unsynchronized systems (one per floor).

As a first assumption, systems are considered unsynchronized, i.e. frames are not aligned; the shift between the first time-slot of the frames of each system is not greater than one time-slot as shown in figure A.2.

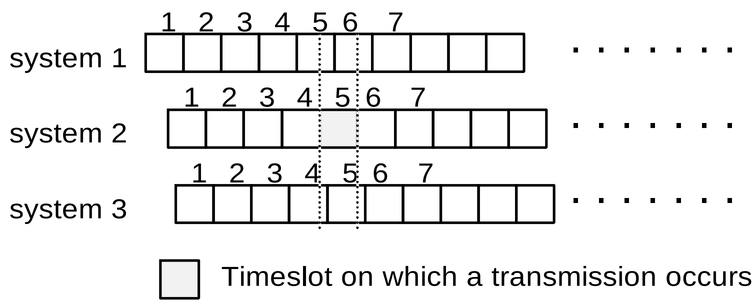

Figure A.2: Three unsynchronized systems in the building

When a single wireless office system is introduced in the building with a floor attenuation of 15 dB, the maximum capacity of the system in terms of Erlangs per RFP reached with a GoS equal to 1 % is about 5,6 E, that corresponds to 9 000 E/km^2/floor; if a higher separation between floors is introduced (i.e. Af = 20 dB), this value becomes 6 E, that is 9 600 E/km^2/floor. Note that blind slot information is not provided in this simulation. This explains the slight discrepancy with the results of clause A.2.

In the second scenario, a different wireless office system is positioned on each floor of the building; terminals can only set-up a call and make handovers with base stations of their system, that is of their floor. Two values on floor attenuation are taken into account: The different systems are unsynchronized. The comparison among the scenarios is shown in figure A.3.

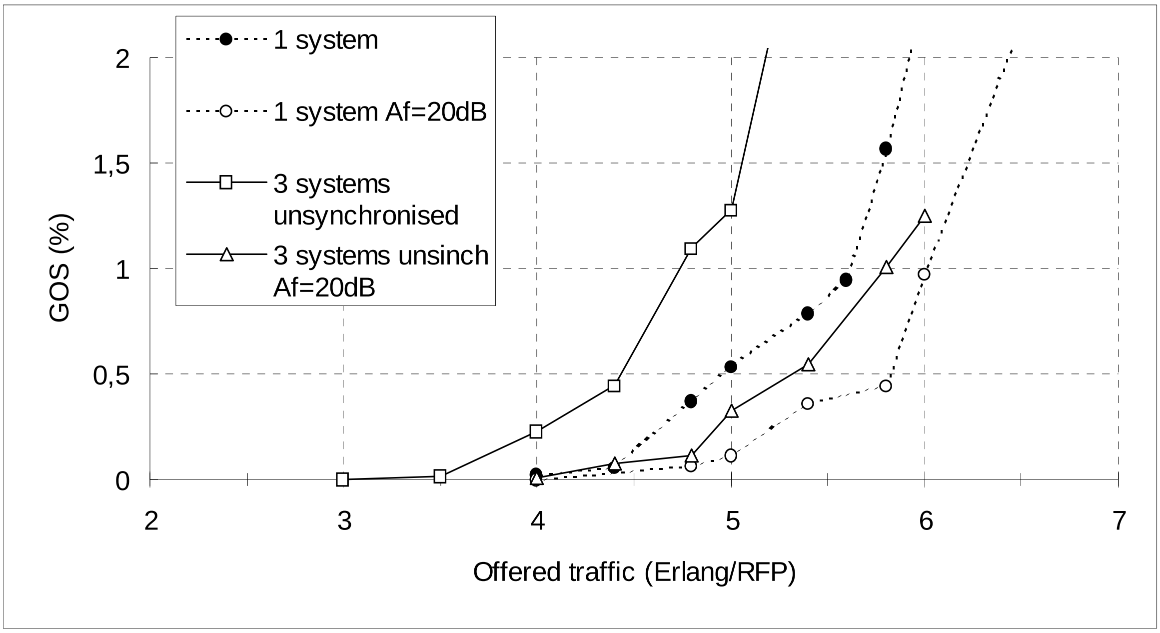

Figure A.3: Offered traffic per RFP with one and three systems in the building

The results obtained by simulations show that coexistence of different wireless office systems, also unsynchronized, is possible with a loss in capacity, in the worst case, less than 20 %; in fact the total capacity obtained is about 7 400 E/km^2/floor, instead of about 9 000 E/km^2/floor for the reference case of 1 system in the building with Af = 15 dB.

Better performance is obtained when the physical separation between different systems is higher, that is when the floor attenuation considered is 20 dB. In fact, in that case, the loss in capacity when 1 system in the building is substituted by 3 unsynchronized systems is almost negligible: The total capacity decreases from 9 600 E/km^2/floor to 9 300 E/km^2/floor.

Table A.4 summarizes the simulation results.

Table A.4: Summary of comparison of capacity for unsynchronized office systems

System types	Af (dB)	Erlangs/RFP	Erlangs/km²/floor
1 system on three floors	15	5,6	9 000
	20	6	9 600
3 systems unsynchronized	15	4,6	7 400
	20	5,8	9 300

A.3 The impact of up-link power control

A.3.1 Introduction

Power control of subscriber units has in the DECT standards been added to the Instant Dynamic Channel Selection (iDCS) procedures. It is called PP power control. It is required, if more than one radio is implemented in the base station. In addition it provides a number of advantages including increased capacity where the DECT environment is dominated by uncoordinated single cell systems.

A.3.2 Power saving

PP power control increases the talk time of subscriber units. For this reason a number of manufacturers of residential DECT systems have already since many years used a simple (two step) open loop power control procedure.

A.3.3 Control of maximum interference and cell sizes

DECT RFP down-link per connection power control is not possible due to the iDCS procedure. It is however possible to have a static reduced power for all down-link transmissions from a specific RFP. A DECT system may have the same reduced power on all RFPs, or have different power on different RFPs, which will result in different "cell sizes". Information on reduced RFP power may need to be broadcast to PPs using open loop power control.

By introducing PP power control no more power will be emitted during a call than what is needed.

A.3.4 Capacity impact

A.3.4.1 Single-radio RFPs and WRSs

A.3.4.1.1 Residential single cell systems

A number of adjacent residential systems appear as a set of mutually unsynchronized RFPs or cells. Since they are unsynchronized, the (in average) lower PP power will reduce the average level of mutual interference and thus reduce the local load on the spectrum.

A.3.4.1.2 Multi-cell systems

Multi-cell systems have all their RFPs synchronized. Since the down-link power is not changed, the down-link capacity will not be changed. Therefore the system capacity is not expected for be very much influenced by the PP power control, which has been confirmed by simulations.

A.3.4.2 Multi-radio RFPs and WRSs

The total capacity of a single-radio RFP is trunk (slot) limited to about 5 or 6 E. A single-radio WRS is trunk limited to about 2 E. The way to increase the local capacity without increasing the number of RFP sites, is the use multi-radio RFPs and WRSs.

In a multi-radio RFP (or WRS) the same time slots will be used simultaneously on different carriers. Therefore it is important to have enough adjacent channel selectivity/power suppression not to cause interference in the RFP between channels using the same time slot. This is not a problem for the down-links, because the down-link power is constant on channels of all radios, and the actual isolation between the channels will be equal to the specified adjacent channel selectivity of the receiver. However, there will be a problem for the up-link when constant up-link power is used, because one subscriber unit can be close to the RFP and another close to the cell range. Therefore the up-link signals received at the RFP on the same time slot (but on different carriers) could differ e.g. 30 dB in field strength, and the specified adjacent channel selectivity will not be sufficient to avoid the weaker signal to be blocked. Thus multi-radio RFPs will not be able to utilize all channels, unless up-link power control is implemented, so that all the up-links are received with equal power at the RFP/WRS.

With PP power control it is feasible to increase capacity by placing several synchronized RFPs or WRSs on the same site or spot, as long as they have the same UL/DL slot notations. This could be useful in office and residential environments. But the for RLL systems where the RFP/WRS sites are very expensive, multi-radio RFPs or collocated RFPs are required, and here the capacity increase by introduction of PP power control becomes important.

A.4 Summary and conclusions

In order to support wide band speech links in dense wireless office systems with a target traffic of 10 000 E/km^2/floor 120 channels will be required. One carrier can provide up to 6 wideband calls. Therefore 20 carriers will be required, corresponding to a spectrum of 40 MHz.

Annex B: Bibliography

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History

Document history		
V1.1.1	August 2013	Publication
V1.2.1	July 2019	Publication